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PATENT
Attorney Docket No.: 7079-6US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Patent application of Bruce L. Bruso	:
Serial No.:	09/841,908	: Group Art Unit: 3673
Filed:	April 25, 2001	:
For:	METHOD OF IN-SITU SOIL REMEDIATION FOR VOLATILE ORGANIC CONTAMINANTS	: Examiner: Mitchell, Katherine W.

Declaration of Inga Carus under 37 C.F.R. 1.132

Commissioner for Patents
Washington, DC 20231

Sir:

I, Inga Carus, hereby declare that:

1. I am Senior Vice President of Sales and Marketing for Carus Chemical Company of Peru, Illinois USA, a division of Carus Corporation, the world's largest manufacturer of potassium permanganate and a leader in providing applications for use of permanganates. One of such uses is for remediation treatment of hazardous waste sites.

2. Permanganate oxidation is an optimal technology for groundwater contamination, particularly for chlorinated organic solvents, including trichloroethylene (TCE) and perchloroethylene (PCE). According to the United States Environmental Protection Agency (USEPA), 80% of all hazardous waste sites in the United States have contaminated groundwater.

3. In addition to groundwater contamination, many waste sites have dense soil that contains contaminated dense non-aqueous phase liquids (DNAPLs). Unlike pooled or flowing

groundwater, DNALPs are not susceptible of being pumped out of the site for treatment. This has lead to the development of in-situ chemical oxidation (ISCO) with permanganate.

4. There are two primary injection methods for ISCO treatment. The first method injects the permanganate on one side of the contaminated zone while extracting groundwater on the other side. Extraction creates a negative pressure zone, causing the permanganate to migrate more quickly through the contaminated zone. Injection can be accomplished either up gradient or down gradient of an aquifer. The second method uses injection without extraction. The permanganate is injected into the contaminant and allowed to migrate through the contaminated zone.

5. The most important factor in the success of ISCO is the ability of the permanganate to reach the contamination. As long as there is contact between the permanganate and the contaminant, the oxidation reaction will take place. This is relatively easy in porous soil, but is difficult in dense silt and clay. With or without extraction, it takes much longer for the permanganate to migrate through the treatment zone in dense soil.

6. To get the greatest impact from permanganate oxidation, it is important to determine the scope and limits of permanganate use. To assist remediation providers in assessing potential permanganate treatment, Carus Chemical provides laboratory services at our facility in LaSalle, Illinois, where we can test soil or water samples for concentration of contaminants and total permanganate demand, based on standardized tests. The latter is a significant factor in soil remediation. The total oxidant demand is a function of the soil's total hydrocarbon composition, not just the concentration of the target contaminant. Soil with high total oxidant demand may require large application of permanganate to achieve the intended level of contaminant reduction.

7. Consequently, I am very encouraged by the process pioneered by Mr. Bruce Bruso, who has successfully used potassium permanganate and sodium permanganate from Carus Chemical to treat difficult contamination sites where high levels of PCE contamination was found in wet clay in DNALP. This type of site is not well suited for oxidant treatment through normal injection methods, since the soil permeability hinders the migration of the oxidant out from the injection point. Migration is also hindered by manganese dioxide, a by-product of the permanganate oxidation reaction, since the manganese dioxide is created as solid particles in the soil.

8. I understand that Mr. Bruso used a patented in-situ treatment for thermal stripping of these sites as a first stage treatment. The stripping is done with a chain trencher modified with hot air injection nozzles and a vapor recovery hood. The trencher continuously lifts and churns the clay in-situ, while injecting hot air into the broken-up clay particles as they are lifted and dropped back along the chain, then moves slightly to repeat the process on an adjacent patch until the entire site has been treated. This thermal stripping step will reduce PCE contamination levels considerably, since PCE is volatile at the hot air temperature, but may not achieve the very low concentrations that are tolerable for PCE and similar toxic materials.

9. What the trencher/hot air stage does in addition to reducing PCE concentration, however, is prepare the site for effective permanganate oxidation. The previously impermeable clay has been broken into small clumps so that the permanganate can easily migrate into contact with PCE inside the clumps. Just as importantly, the total oxidant demand will be significantly reduced by the stripping of natural and other hydrocarbons along with the PCE reduction. The result is a site with good soil permeability, low total oxidant demand, and a low-level concentration of PCE that must be further reduced to very low levels. Good soil permeability

and lower oxidant demands represent optimal conditions for permanganate oxidation. The amount of permanganate required for this second stage treatment may be lower by a factor of ten or more than the amount that would have been be required without the first stage reduction of the total oxidant demand.

10. I believe that Mr. Bruso's process of the thermal stripping while breaking up the dense soil, followed by permanganate oxidation, will be a preferred treatment plan for PCE and similar contaminants in wet impermeable soil. I regard it as a significant new treatment with great potential. I do not know of anyone previously having performed the same process described by Mr. Bruso, nor of anyone who has made suggestions to me on the use of such process. I do not believe that it would have been an obvious process to me or to others involved with hazardous waste treatment until it was demonstrated by Mr. Bruso.

11. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 3 Mar 03 _____

INGA CARUS